

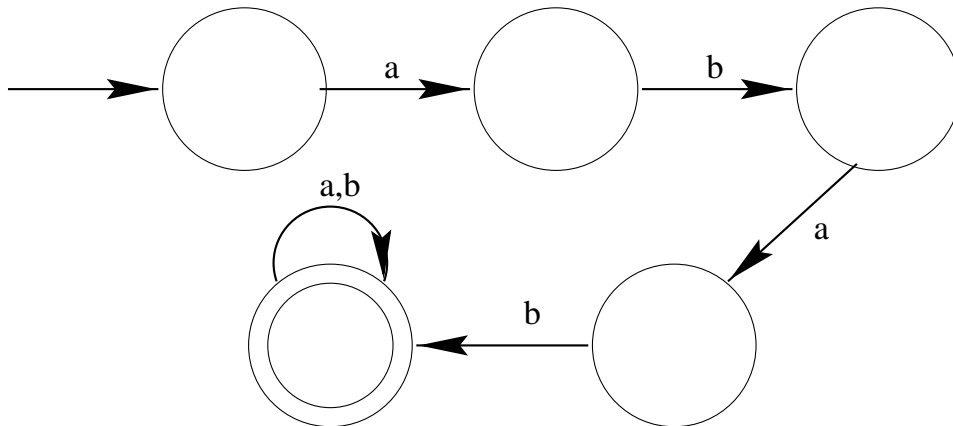
CMSC 330 HOMEWORK EXERCISES #1

Problems. In each of the following problems you are given a language and are asked to produce a regular expression and/or finite automaton for the language. In some cases you are asked to give “either” a DFA or regular expression (your choice) and in other cases to give “both” a DFA and regular expression. When writing regular expressions, use the shorthand ϵ to denote the empty string. Write DFA’s in the form of a transition diagram. The underlying alphabet is $\Sigma = \{a, b\}$.

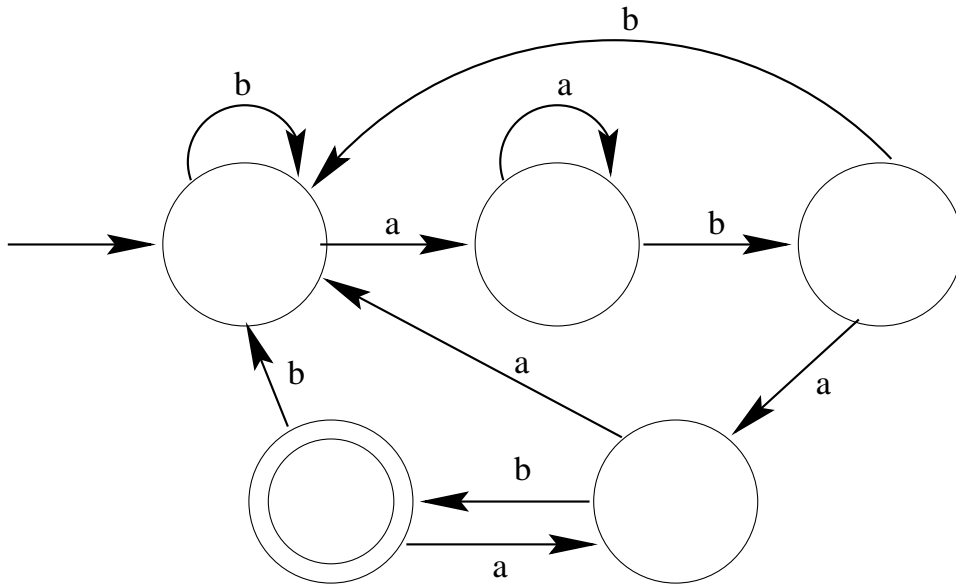
The notation $\#a(w)$ appearing below means the number of a ’s occurring in string w . For example, $\#a(bbaba) = 2$.

Note that in all the DFAs shown, missing transitions signify a transition to a dead state (a non-final state with transitions back to itself on all elements of the input alphabet).

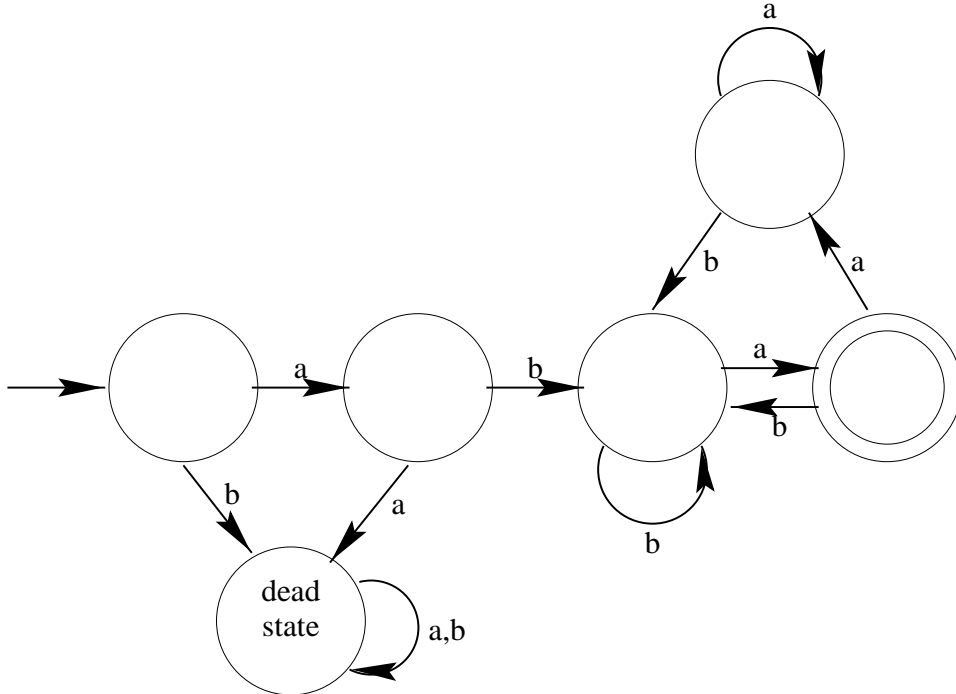
1. (Either DFA or Reg. Exp) $\{w \mid w \text{ begins with } abab\}$.



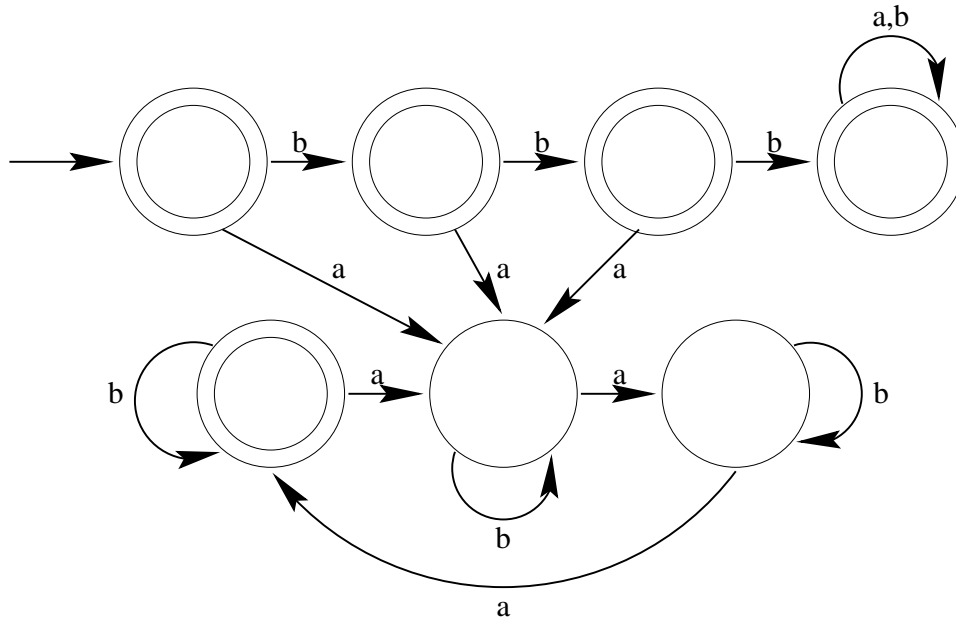
2. (Either) $\{w \mid w \text{ ends with } abab\}$.



3. (Either) $\{w \mid w \text{ begins with } ab \text{ and ends with } ba\}$.
 (Note: The string aba is in this language!)

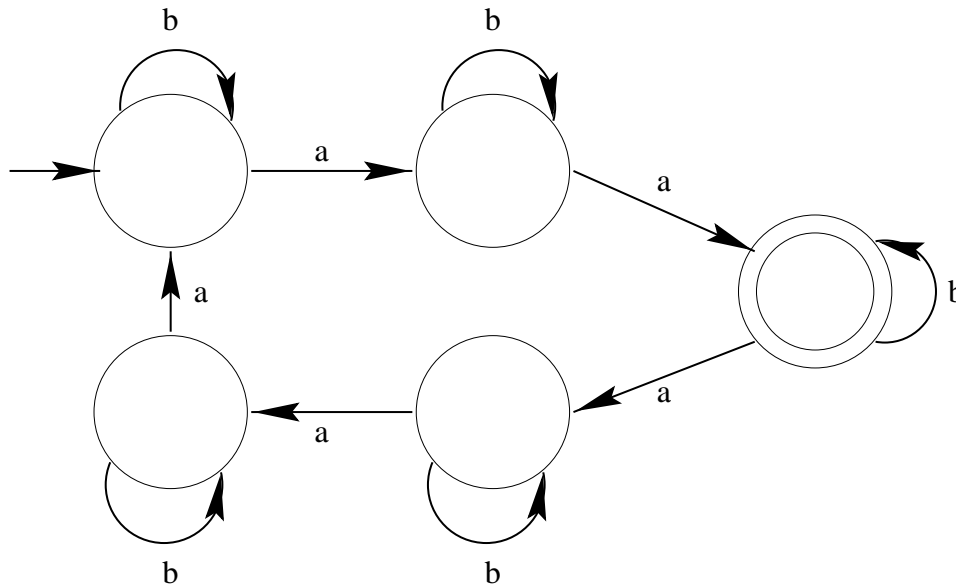


4. (Either) $\{w \mid \text{either } \#a(w) \text{ is divisible by 3 or } w \text{ begins with } bbb\}$.

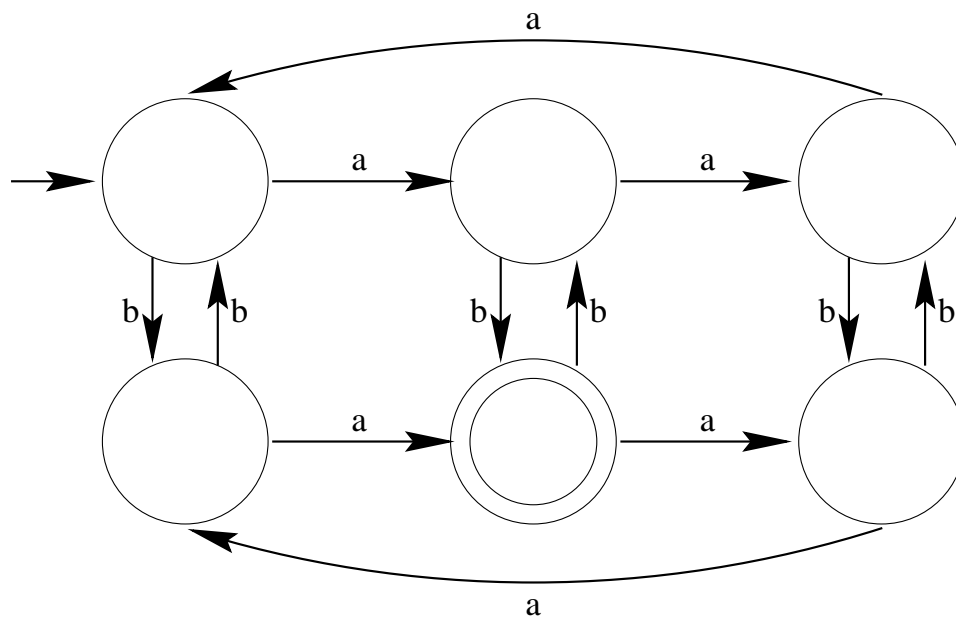


5. (Either) $\{w \mid \#a(w) \equiv 2 \pmod{5}\}$.

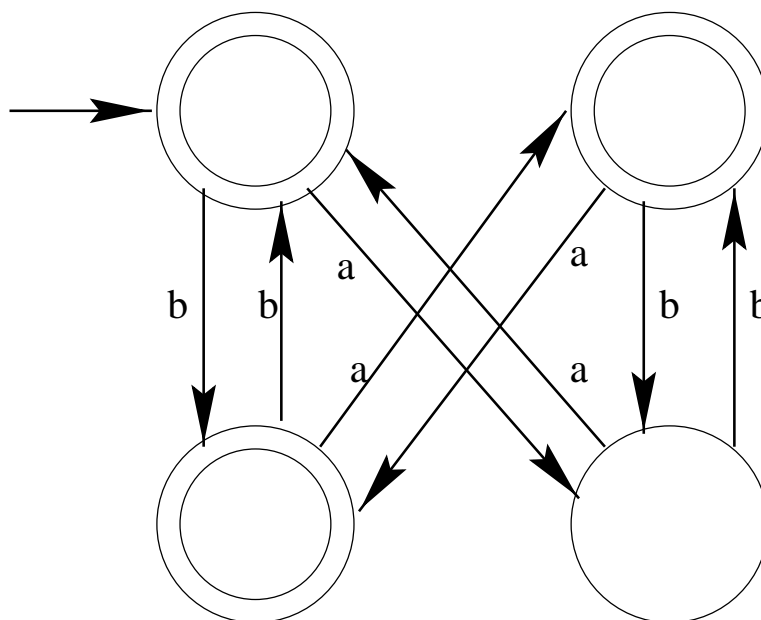
(Recall that $i \equiv j \pmod{k}$ if and only if $(i - j)$ is divisible by k .)



6. (Either) $\{w \mid \#a(w) \equiv 1 \pmod{3} \text{ and } \#b(w) \text{ is odd}\}$.

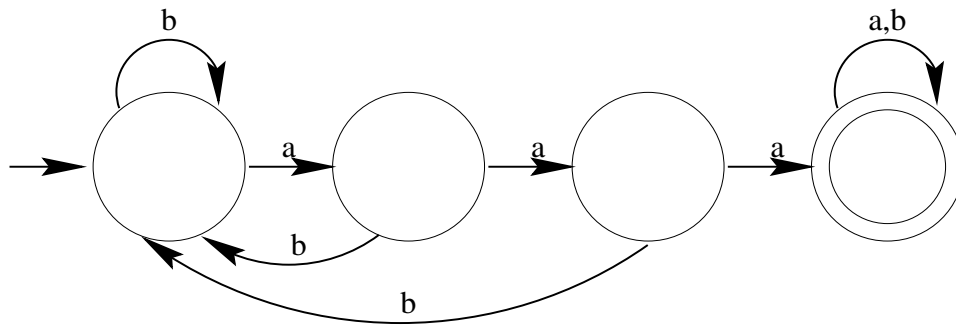


7. (Either) $\{w \mid \#a(w) \text{ is even or } |w| \text{ is even}\}$.



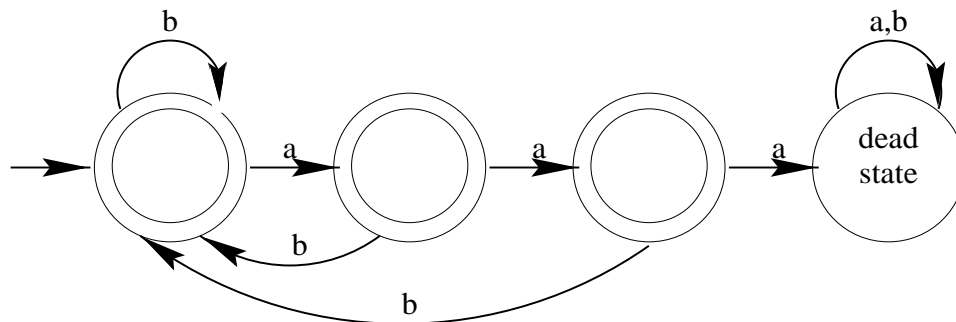
8. (Both DFA and Reg. Exp) $\{w|aaa \text{ is a substring of } w\}$.

$$(a|b)^*(aaa)(a|b)^*$$

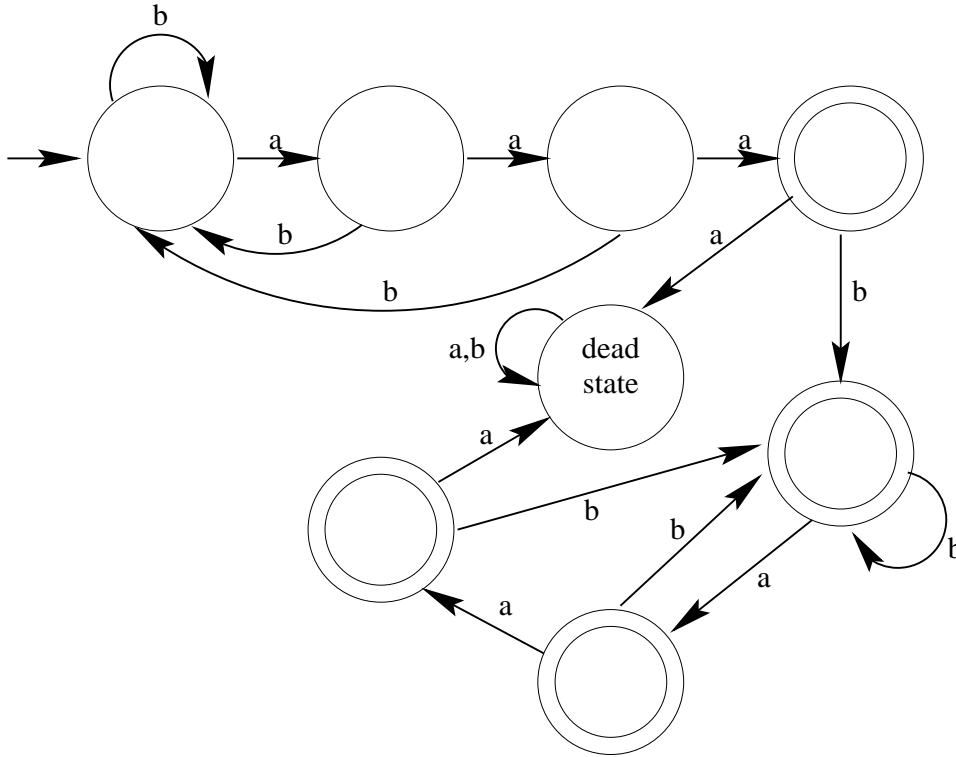


9. (Both) $\{w|aaa \text{ is not a substring of } w\}$.

$$(b^*(\epsilon|a|aa)b)^*(\epsilon|a|aa)$$



10. (Either) $\{w \mid w \text{ contains exactly one occurrence of the substring } aaa\}$.
 (Note: the string $aaaa$ has two occurrences of aaa !)



11. (DFA only) $\{w \mid \text{neither } aa \text{ nor } bb \text{ is a substring of } w\}$.

